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A Systematic Review of Significant Skills Improvement in Laparoscopic Simulation Training Surgical Techniques in General Surgeries

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Abstract: **Laparoscopic surgery has become the "gold standard" for common for typical surgeries such as appendectomies and cholecystectomies. Surgical simulators have an increasing function in the guideline and training in surgical abilities, and simulation-based training with natural experiences has the prospective to make a substantial contribution to advancement of the surgical curriculum. The aim of this systematic review was to determine whether skills acquired through simulation-based training are transferable to the operative setting. Studies were identified by searching MEDLINE, EMBASE, CINAHL, Current Contents, PubMed, and the Cochrane Library, from the inception of the databases to October 2016. The York (UK) Centre for Reviews and Dissemination databases, Clinicaltrials.gov, National Research Register, Meta-Register, and the Australian Clinical Trials Registry were also searched in October 2016. Laparoscopic surgery is particularly well suited to technical skills training as it requires a skill-set based on instrumentation, depth perception, and fine motor control. The aim of this systematic review was to determine whether skills acquired through simulation-based training are transferable to the operative setting.**

Keywords: **Laparoscopic surgery.**

1. INTRODUCTION

Laparoscopic surgery has become the "gold standard" for common for typical surgeries such as appendectomies and cholecystectomies [(1)]. Surgical simulators have an increasing function in the guideline and training in surgical abilities, and simulation-based training with natural experiences has the prospective to make a substantial contribution to advancement of the surgical curriculum [(2)]. A surgical training program ought to integrate training for nontechnical and technical abilities, and for working as part of a group in the operating space, to make the most efficient usage of readily available resources and to make the most of patient security. Simulation-based training programs were at first "add-ons" to conventional surgical training, simulation-based training is significantly being included into curricula or even mandated by registration bodies, such as the American Board of Surgery that has required Fundamentals of Laparoscopic Surgery (FLS) certification since 2009 [(3)].

In 2007, one group has published a systematic review which concluded that simulation-based training appeared to lead to abilities transfer to the personnel setting [(4)]. It was kept in mind that the included research studies were of variable quality and style that restricted the strength of this conclusion. Ever since, the variety of research studies resolving transferability of simulation-based abilities to the personnel setting has actually increased [(5)]. The basic presumption of simulation-based training is that the abilities obtained in simulated settings are straight transferable to the personnel setting. The efficiency of private simulators to teach procedural abilities has yet to be shown [(6,7)]. Lots of research studies have actually shown better simulator efficiency after simulator training,[(8)] and others have actually shown improved surgical performance in anesthetized animals after simulation-based training [(9,10,11)].

The aim of this systematic review was to determine whether skills acquired through simulation-based training are transferable to the operative setting.

2. METHODOLOGY

A systematic review was undertaken according to PRISMA guidelines [14] (of literature relating to laparoscopic simulation training techniques

Literature Search Strategies:

All randomized controlled trials (RCTs) and nonrandomized comparative studies also we included systematic reviews studies discussing the use of laparoscopic simulation based training, and the transfer of these skills to the surgical setting were included for review. Studies were identified by searching MEDLINE, EMBASE, CINAHL, Current Contents, PubMed, and the Cochrane Library, from the inception of the databases to October 2016. The York (UK) Centre for Reviews and Dissemination databases, Clinicaltrials.gov, National Research Register, Meta-Register, and the Australian Clinical Trials Registry were also searched in October 2016. Searches were conducted without language restriction. The search terms used were (laparoscopic surgery and simulate) and (skill or train). Pearling was then undertaken to locate any articles that may have been missed by the electronic database searches.

Inclusion Criteria:

Included studies contained information on measures of task performance in the simulated setting and the operative setting, including accuracy of skill/technique, time to complete skill/technique, efficiency of movement, and error rates. Reviewers independently examined all retrieved studies and any disagreement over inclusion or exclusion was discussed and a consensus reached.

Data Extraction and Analysis:

Data from all included studies were extracted by one researcher and checked by a second using standardized data extraction tables developed a priori. Each included study was critically appraised for its study quality and assigned a level of evidence according to the hierarchy of evidence developed by the National Health and Medical Research Council of Australia.

3. RESULTS AND DISCUSSION

We have included 30 studies that met our included criteria **Table1** describes the types of simulators implemented in many consisted of research studies, producers for the simulators, meanings for the simulators, and efficiency abilities the simulators supply.

In an organized evaluation carried out in 2006 [12], scientists discovered that students get comparable medical outcomes as cosmetic surgeons in laparoscopic colorectal surgery, if monitored by a professional throughout training [12] nevertheless, this evaluation was restricted just to colorectal surgical treatments.

In a various methodical evaluation, detectives reported that simulation training might not be a much better technique than patients, cadavers, and animals for mentor surgical abilities [2], however the abilities discovered by simulation-based training seemed transferable to the OR. This evaluation carried out by Strum and scientists [2] was restricted to 11 released research studies and was performed in 2008. Gurusamy and coworkers [13] discovered that virtual truth training can supplement laparoscopic surgery training, however irregularity throughout research study styles and clashing findings in the released research studies avoided the confirmation of clear best practices.

Table1: Laparoscopic training tools, definitions, manufacturers, and procedures commonly trained in surgery

Type of Simulation	Definition	Manufacturer	Camera Navigation	Clipping & Cutting	Suturing & Knot Tying
Box Trainer	**A box that incorporates conventional laparoscopic equipment to perform basic skills, is versatile, and enables training on**	Simulab Corporation	X	X	X

Type of Simulation	Definition	Manufacturer	Camera Navigation	Clipping & Cutting	Suturing & Knot Tying
	animal parts as well as synthetic inanimate models				
Task Trainer	**A partial component of a simulator or simulation modality, for example, an arm, leg, or torso.**	Limbs and Things		X	X
MIST-VR	**A virtual reality simulator with six different tasks to simulate maneuvers performed during laparoscopic cholecystectomy in a computerized environment.**	Mentice AB	X	X	
LapMentor/ LapMentor II	**A virtual reality simulator consisting of a camera and two calibrated working instruments for which the motion of the instruments is translated to a two-dimensional computer screen for student practices.**	Simbionix Ltd.	X	X	X
LapSim	**A computer-based simulator creating a virtual laparoscopic setting through a computer operating system, a video monitor, a laparoscopic interface containing two pistol-grip instruments, and a diathermy pedal without haptic feedback**	Surgical Science	X	X	X
EndoTower	**EndoTower software consists of an angled telescope simulator composed of rotating camera and telescopic components.**	Verefi Technologies, INC.	X	X	
MISTELS/ FLS trainer	**McGill Inanimate System for Training and Evaluation of Laparoscopic Skills – this inexpensive, portable, and flexible system allows students to practice in a virtual Endotrainer box.**	SAGES		X	X
SIMENDO VR	**Computer software used to train eye-hand coordination skills by camera navigation and basic drills.**	Delta Tech	X		X
URO Mentor	**A hybrid simulator, consisting of a personal computer based system linked to a mannequin with real endoscopes. Cytoscopic and ureterosciopic procedures are performed using either flexible or semi rigid endoscopes**	Simbionix Ltd.	X	X	
Da Vinci Skills Simulator	**A portable simulator containing a variety of exercises and scenarios specifically designed to give users the opportunity to improve their proficiency with surgical controls.**	Intuitive Surgical	X	X	X

Suturing, Cutting and Cautery Skills (3 studies) and performance errors (10studies):

Three of the 30 studies [(15,16,17)] reported significant improvement on suturing, cutting, and cautery skills in the trained group as compared to the control group. Investigators reported that the trained participants outperformed the control participants in the performance of safe electrocautery ($P < .01$).

Ten of the studies [(10,18-26)] assessed whether simulation-based training resulted in a decrease in errors. Errors were reported as clipping errors, dissection errors, tissue damage, incorrect plane for dissection, lack of progress, and instrument out of view. All ten-research articles reported Performance errors were described as movements or events outside the normal procedure. three studies [(24,25,26)] examining this outcome reported significant reductions in errors for simulator-trained participants compared with con-trol trainees who did not have this training (*P* 0.003,[24] *P* 0.006; [25] *P* 0.01 after 5 hours training and *P* 0.01 after 10 hours of training[26]).

Performance Time, Simulation-Based Training versus No Simulation-Based Training (6 Studies):

Performance time was reported as the time taken, in minutes or seconds, to conduct the patient-based assessment procedures. Three of 5 [(24, 26, 27)] studies found time improvements for simulator-trained participants compared with participants who did not have this training (*P* 0.021, [24] *P* 0.008, [27] *P* 0.01[26]). Two studies ([25, 28)] found no time differences between the 2 groups. The study comparing simulator-based training with patient-based training[29] also found no time differences between the 2 groups.

***Economy of Movement evaluation* (8 Studies):**

Eight of indentified studies [(1,16,31-35)] assessed if simulation-based training resulted in an increase in the economy of movement. Economy of movement was reported as camera navigation, efficiency of instrument, total path length, number of movements, navigation, and bimanual dexterity. The eight studies [(1,16,31-35)] reported statistical findings that the intervention increased the economy of movement. More specifically, training was significantly related to path length ($P<.001$) and total number of movements ($P =.009$) [(31)]. In contrast, investigators found no difference in economy of movement between the control and intervention groups ($P =.40$) [(1)]. In two different studies, researchers found that the control groups did not show significant differences compared to the intervention group as related to economy of movement [(1,33)].

4. CONCLUSION

Laparoscopic surgery is particularly well suited to technical skills training as it requires a skill-set based on instrumentation, depth perception, and fine motor control. The aim of this systematic review was to determine whether skills acquired through simulation-based training are transferable to the operative setting. The studies included in this review were of variable quality and design, which showed evidance available demonstrates that simulation-based training results in skills transfer to the operative setting. The challenges to surgical training are substantial and simulation has the potential to make a significant contribution to the evolution of surgical curriculum. It is very important that further studies be undertaken to provide the best evidence to determine how simulation-based training can be used in the most beneficial way.

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